THE STATE *of the* STATISTICS

`Substantial data exist about the transportation system, but fall short of providing the information needed to inform policymakers about the strategic issues facing the U.S. Department of Transportation."[1] To address this problem, the Bureau of Transportation Statistics (BTS) is required by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) to provide "documentation of methods used to obtain and ensure the quality of the statistics presented in the [annual] report." BTS interprets this requirement as a mandate to evaluate the state of transportation statistics used to assess the state of the transportation system, and to identify needed priorities among improvements to the data and methods underlying those statistics.

Methods for Assessing the State of Transportation Statistics

Comprehensive assessments of transportation statistics have been published at least since 1969.[2] The most recent effort, documented in *Data for Decisions: Requirements for National Transportation Policy Making*,[3] is a classic example of the comprehensive approach. Information needs and resources are catalogued in a comprehensive review of data users and providers, gaps are identified, and priorities are established through the budget process.

The comprehensive approach starts with a listing of fundamental questions about transportation and its consequences—what we need to know about freight transportation, what we need to know about passenger transportation, and why we need to know those things for public policy. (See table 8-1). The list is updated from a similar table in *Data for Decisions*. For each item in Table 8-1, we must ask three questions to evaluate our state of knowledge:

- Do we know how to measure the

item in question? (Do we know how to define the concept in a way that can be quantified and unambiguously interpreted? Do we have the analytical or data collection skills to turn the definition into a useful statistic?)
- Do we have quality data to measure the item in question? (Have we applied the data collection skills to feed the desired statistic?)
- How well can we describe and understand the trends involving the item in question?

The answers to these questions will vary by item in question, by mode of transportation, and by level of geography. (See figure 8-1.)

BTS also uses a market-response approach to assessing data needs, recognizing that the broad sweep of comprehensive assessments tend to be retrospective. Although many transportation issues and information needs have a long history, new topics do emerge and new technology creates opportunities for innovative data products that do not fit traditional molds. Comprehensive assessments also provide little guidance on setting priorities among proposed data programs. For these reasons, BTS emulates the private sector by developing some prototype data products independent of its strategic plan, and by carefully assessing user reaction to both new and established products to determine whether BTS is meeting the needs of the transportation community.

BTS has not been in existence long enough to gain extensive insights on data needs from the market-response approach. Customer reactions can take several months to evolve after release of a product, and BTS has been in operation only since December 16, 1992. The Bureau's one product developed early enough (in January, 1993) to stimulate detailed customer reactions is the *Transportation Data Sampler* CD-ROM.

The *Transportation Data Sampler* CD-ROM was an introduction to the variety of information resources within DOT and allied agencies, and serves as a test of compact disk-read only memory (CD-ROM) technology for the dissemination of data products. This *Sampler* contains data bases and reports in a variety of spreadsheet, data base, and word processing formats, and includes a user response form that asks for comments on the content, formats, and other aspects of the product. Resulting comments by telephone, fax, and letter have provided insights on the utility of the included data sets, their ease of use, and desires for additional data items, and have increased BTS awareness of the need for search and retrieval software on CD-ROM products.

Selected Contents of the *Transportation Data Sampler* CD-ROM

- Summary statistics from publications such as Highway Statistics, the FAA Statistical Handbook of Aviation, the 1990 Nationwide Personal Transportation Survey, and selected publications on water transportation by the Maritime Administration and the Corps of Engineers
- Individual records from the 1990 Nationwide Truck Activity and Commodity Survey, a year's worth of the Fatal Accident Reporting System and the General Estimates System of police-reported traffic crashes, and the Federal Aviation Administration's inventories of air carrier aircraft, general aviation aircraft, and aircraft engines.
- The complete 1990 Rail Waybill public use file of the Interstate Commerce Commission.
- Geographic data bases on the highway and railroad networks and on airports for analytical studies, routing analyses, and mapping.
- Text files such as an overview of the Hazardous Materials Information System, an annotated bibliography of recent publications on the environmental effects of transportation systems, and the Intermodal Surface Transportation Efficiency Act of 1991.

Perspectives on the Current State of Transportation Statistics

Although BTS has not had the opportunity in its brief existence to develop its own comprehensive assessment or assess

TABLE 8–1

What We Need to Know About Transportation

What We Need to Know About Freight Transportation	What We Need to Know About Passenger Transportation	Why Do We Care? (for public policy, infrastructure planning and market analysis)
What moves? How much moves?	Who travels? How much Travel?	Source of transport demand, basic input to following questions; most direct beneficiaries of transportation investments.
How valuable is the material being moved?	Why do they travel?	Importance of demand to the economy and to carriers, linkages of transportation to social condition and economic structure.
How far is the move?	How far is their travel?	Aggregate measure of transport to be consumed.
From where to where?	From where to where?	Location of transport facilities and services to be consumed; geographic regions and corridors to be affected by trade and social interaction.
What main mode was used?	What main mode was used?	Basic input to debates over intermodal competition and promotion activities.
What other modes were used?	What other modes were used?	Demand for intermodal connections and local access.
Do the links, nodes, and service providers cover current and anticipated origins and destinations?	Do the links, nodes, and service providers cover current and anticipated origins and destinations?	Most basic system performance measure: can you get there from here?
How much of the system capacity (links, nodes, vehicles, services) are consumed by current and anticipated movements?	How much of the system capacity (links, nodes, vehicles, services) are consumed by current and anticipated travel?	Market consequence of demand for transportation; basic input to estimates of adequate system capacity and consequences of transportation.
Do the links, nodes, and service providers have enough capacity for current and anticipated movements?	Do the links, nodes, and service providers have enough capacity for current and anticipated travel?	Physical capacity of the system to service basic demand for transportation.
How costly to the service and infrastructure providers are the movements between origins and destinations?	How costly to the service and infrastructure providers are the movements between origins and destinations?	Efficiency and effectiveness of the transportation system to the service or infrastructure provider.
How much of the costs to serve and infrastructure providers is public versus private?	How much of the costs to serve and infrastructure providers is public versus private?	Investment requirements; cost allocation; privatization issues.
How costly to the shipper are the movements between origins and destinations? (Prices)	How costly to the traveler are the movements between origins and destinations? (Prices)	Efficiency of the transportation system to the user, source of the system's consequences for economic productivity and internatjional competitiveness; market analysis.
How timely are the movements between origins and destinations? (Traveltime, system speed)	How timely are the movements between origins and destinations? (Traveltime, system speed)	Effectiveness of the transportation system to the user; source of user satisfaction and the system's consequences for economic productivity and international competitiveness; market analysis.
How reliable are the movements between origins and destinations?	How reliable are the trips between origins and destinations?	Quality of the transportation system to the user; source of user satisfaction and the system's consequences for economic productivity and international competitiveness; market analysis.
How likely is the shipment to be damaged, lost, or stolen?	How likely is the traveler to be hurt or luggage damaged?	Safety and security.
Who is the service provider?	Who is the service provider?	Direct beneficiaries of transportation investments; accountability for operation of the transportation system.
What is the financial condition of the service provider?	What is the financial condition of the service provider?	Ability of service providers to maintain and improve performance and safety; susceptibility to foreign ownership and legal complications.
Who is the shipper? Who is receiving the shipment?	If the travel is for business, what industry is being served?	Economic sectors receiving direct benefits from transportation investments.
Who else is dependent on the shiment?	Who else is dependent on the travel?	Others receiving direct benefits from transportation investments.
How much damage is done to the physical infrastructure?	How much damage is done to the physical infrastructure?	Establishment of investment needs; allocation of costs among users and others.

continued

TABLE 8–1

What We Need to Know About Transportation (Continued)

What We Need to Know About Freight Transportation	What We Need to Know About Passenger Transportation	Why Do We Care? (for public policy, infrastructure planning and market analysis)
What is the risk of health-threatening mishaps?	What is the risk of health-threatening mishaps to bystanders?	Safety; hazardous materials.
How much damage is done to air quality?	How much damage is done to air quality?	Clear Air Act requirements.
How much damage is done to water quality?	How much damage is done to water quality?	Wetlands preservation and related environmental protection requirements.
How much noise and other pollution is created?	How much noise and other pollution is created?	One of the politically sensitive conflicts between environmental concerns and interstate commerce.
How much energy is consumed?	How much energy is consumed?	Energy conservation; national security.
Who is affected by these externalities?	Who is affected by these externalities?	Societal consequences of transportation.
What is affected by these externalities?	What is affected by these externalities?	Consequences of transportation for endangered species and environmental concerns.

market responses in a thorough, rigorous manner, the Bureau has a clear sense of major problems with transportation statistics based on a quarter century of studies, a year of meetings, and the legislation that created the Bureau. The major problems are consistent across perspectives of Congress, DOT, and the transportation community as portrayed by the National Academy of Sciences.

Perspectives of Congress

Congressional concerns with transportation statistics have been expressed in ISTEA. ISTEA organizes those concerns in the six functional areas for BTS, and expands on those concerns in the specific subjects and projects within those areas:

- Compile and analyze statistics, particularly related to 11 major topics to be covered in the *Transportation Statistics Annual Report*.
- Collect data on subjects that transcend or fall between existing DOT's existing statistical programs, specifically including an Intermodal Transportation Data Base to be created by BTS for the Office of Intermodalism.
- Establish guidelines to improve comparability and quality of DOT statistics, and convene an Advisory Council on Transportation Statistics to assure quality and relevance of BTS products.
- Represent transportation in the statistical community.
- Make statistics accessible and understandable.
- Identify data needs through ongoing BTS activities and through a one-time study by the National Academy of Sciences.

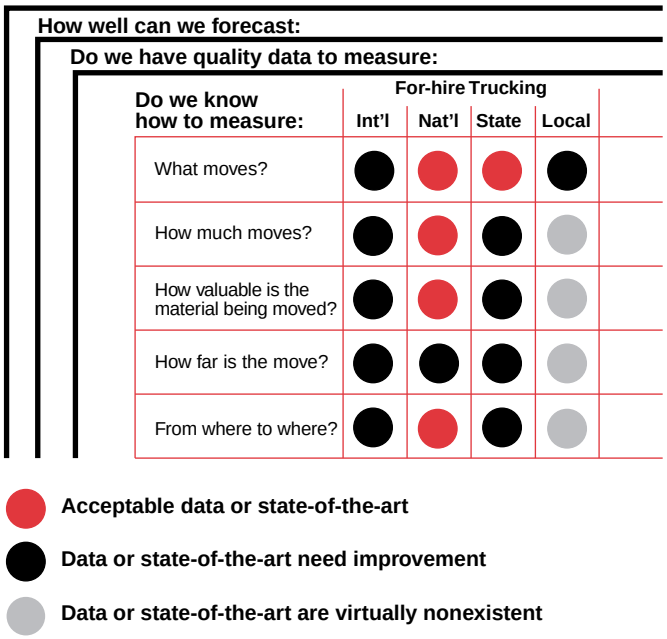
DOT Perspectives

Additional concerns by DOT with the state of transportation statistics have been expressed through discussions of the Intermodal Transportation Advisory Board (ITAB), which consists of DOT modal administrators and secretarial officers. In response to departmentwide needs, modal administrations have suggested that BTS:

- identify data and tools to define and analyze the proposed National Transportation System;
- take the lead in defining and implementing better measures of economic productivity of the transportation industry;
- improve information on international transportation by resurrecting the Survey of Domestic Transportation of U.S. Foreign Trade and helping the modal administrations negotiate for better data from the Customs Service and other agencies;
- provide a forum in which the modes can share forecasts of transportation,

FIGURE 8–1

Tracking the State of Knowledge



economic, and demographic variables to improve the quality and consistency of those forecasts;

- coordinate purchases of data from private vendors to avoid duplicative purchases, to achieve economies of scale, and to assure that all parts of DOT have access to common data sources;
- supplement the Nationwide Personal Transportation Survey and similar data collections to improve coverage accuracy, especially for modes such as transit and intercity rail passenger service that are not ubiquitous;
- identify and capture opportunities to piggyback transportation questions on the Censuses of Manufacturing, Agriculture, Wholesale and Retail Trade, and Governments;
- undertake studies of multimodal-modal and intermodal trends, such as the effects of *edge cities* on transportation demand and the impacts of flooding on freight transportation; and
- help the modes develop better information on transportation costs.

BTS has also been asked to assist individual modal administrations in projects such as:

- the Federal Highway Administration's Overweight Container Enforcement Study;
- the Federal Aviation Administration's survey of general aviation;
- travel behavior surveys in high-density corridors for the Federal Transit Administration;
- expansion of the Economic Census to short-line railroads for Federal Railroad Administration;
- a CD-ROM on hazardous materials transportation for the Research and Special Programs Administration and the Coast Guard;
- analyses of freight transshipments through the U.S. (without stopping) and cargo diversion to Canada for the Maritime Administration; and
- the integration of health care statistics related to highway accidents for the National Highway Traffic Safety Administration.

Perspectives of the National Academy of Sciences

The specific ISTEA mandate for BTS reflects a larger concern with the information base upon which decisions can be made, and with the visibility of transportation needs in public debates over resource allocation. Major information gaps and analytical needs are identified in *Data for Decisions*. This report, authored by a panel of experts from throughout the transportation community with extensive input from DOT's modal administrations, defines major topics for BTS beyond the specifics of ISTEA:

- BTS should provide departmental leadership in advancing geographic information systems (GIS) technology, methods of data acquisition (particularly with respect to Electronic Data Interchange and Global Positioning Systems), and protection of confidentiality of data on individuals, households, and businesses.
- BTS should develop and publish better measures of systemwide performance, providing a more accurate picture of how well the transportation system works from the user perspective.
- BTS should analyze transportation's role in the economy, its environmental and energy consequences, and its ability to support national security and emergency preparedness.

TABLE 8 – 2

Illustrations of Key Data Deficiencies

Data Category	Data Deficiency	Agencies Involved in Data Compilation	National Policies Served
Supply and demand	Passenger and commodity flow data	DOT; Bureau of the Census	Congestion alleviation; investment decisions; system capacity for civilian and defense needs
Performance	Exposure data	DOT	Identification and monitoring of major system safety and security problems; evaluation of alternative safety regulations
Safety and personnel security	Reporting of injuries and nonfatal accidents		
	Measures of system security		
Access	Measures of availability, use and cost of transport services in rural and small urban areas and for handicapped, elderly, and low-income populations	DOT; DOA; DHHS	Investment decisions and development strategies; evaluation of costs and benefits of alternative service delivery mechanisms
Service delivery	Measures of service quality	DOT	Investment decisions; identification of impediments to transportation performance affecting economic growth and international trade
	Measures of intermodal performance	DOT; Bureau of the Census; U.S. Customs Service	
Impacts on other national objectives			
Economic growth	Measures of transportation impacts on industrial profitability	DOT; BLS; BEA; Bureau of the Census	Articulation of value of transportation to economic growth; investment policies to support U.S. competitiveness
	Expanded data on specific transportation service sectors and their relative contribution to productivity of the sector as a whole		
National Security	Location, condition, and use of transportation facilities	DOT; DOD	Investment strategies for improved military deployment; economic impacts of alternative levels of demand
Environmental quality/land use	VMT, speed data, and other measures of transportation impacts on air quality	DOT; EPA; DOE; states; other agencies with environmental missions	Evaluation of environmental impacts of alternative transportation investments
	Measures of transportation impacts on global warming, wetlands degradation, water and noise pollution, and other environmental concerns		Identification of magnitude and effects of transportation impacts on the environment; development of policies to mitigate adverse impacts
Energy use	Improved measures of vehicle fuel efficiency	DOT; DOE	Evaluation of energy performance of alternative transportation modes; monitoring energy performance of the transportation sector

Note: VMT=vehicle miles traveled; DOT=Department of Transportation; EPA=Environmental Protection Agency; DOE=Department of Energy; DOD=Department of Defense; DOA=Department of Agriculture; DHHS=Department of Health and Human Services; BLS=Bureau of Labor Statistics; BEA=Bureau of Economic Analysis

Perspectives of Other Federal Agencies: The Case of the Department of Defense

The Department of Defense is a major user of civilian transportation facilities and services at home and abroad, as illustrated by the significant demands for *just-in-time* delivery of the military force and supporting civilian activity during the Persian Gulf War. As discussed in *Data for Decisions,* the transportation system was able to cope with the stress because the recessionary economic environment of the time created considerable slack in the system.

Data for Decisions states that the DOT Secretary "should be able to assess what impact different levels of demand, military and civilian, would have on economic performance; identify where added investment in facilities would provide the greatest benefits in improved military deployment capability; and evaluate how the special requirements of military equipment (e.g., ammunition shipped in containers) would affect commercial activity."

The report further notes that:

> *Collecting the data to address these questions is complex, time-consuming, and costly, because of the special characteristics of defense transportation data requirements. First, the data must be precise regarding the location, physical characteristics, and performance capabilities of transportation facilities. For example, it is not enough to know that there are three bridges rated structurally deficient on primary highways in the metropolitan Miami area. Data on condition and use must be linked directly to specific facilities at specific locations on strategic defense highways. Second, the data must be comprehensive. Defense transportation data needs are concerned with all transportation modes and how they interact; it is frequently at the links between the modes—rail or highway connections to ports, for example—where delays and breakdowns in transporting equipment occur.*[4]

Transportation data concerns of the Department of Defense cut across the

Findings and Recommendations in *Data For Decisions*

Transportation data are plentiful, but inadequate for national policymaking. The biggest gap in DOT's multimodal data programs is in passenger and freight flow data. These data provide basic system information on who or what is moving, by what mode, and from where to where; they are also basic input for other desired system indicators. Flow data provide an exposure measure for calculating accident rates per passenger-mile or ton-mile. They are a critical input to forecasts of vehicle activity, which affect projections of congestion, estimates of emissions levels in urban areas with unacceptably high levels of ozone and carbon monoxide, and monitoring of energy use by the transportation sector. A departmental priority should be the collection of national passenger and freight flow data, which have not been gathered since 1977. Although national surveys will not provide the data for detailed analyses of local congestion or air quality problems, additional sampling in major transportation corridors and urban areas should provide adequate detail for national monitoring and analysis purposes.

Development of [a national transportation performance monitoring system] will also require improving the comparability of data collected on individual transportation modes to enhance inter modal comparisons and provide an assessment of overall system performance. Existing data must also be integrated and supplemented to enhance the capability of the department to determine the contribution of the transportation system to such other national objectives as economic growth, national security, environmental quality, and energy use. DOT must work cooperatively with the operating administrations, other federal agencies, and the states to develop these data.

Opportunities for using data that are gathered by the private sector or collaborating with the private sector in data collection efforts should be explored as an alternative to new data collection efforts. Advances in data gathering and information processing technologies have the potential to reduce costs and reporting burdens while improving the speed and reliability of data collection and analysis. The areas of greatest opportunity for application to developing [a national transportation performance monitoring system], such as automated surveying methods, electronic linking of records through [electronic data interchange], automated vehicle and traffic monitoring through [intelligent vehicle highway systems] technologies, and integration of data into [geographic information systems] for analysis, should be carefully investigated.

TABLE 8 – 3

Definitions and Criteria Currently Used to Measure Fatalities by Mode of Transporation

Mode	Terminology	Definition	Criteria/Exclusions
Air Carrier	Fatal Injury	Any injury which results in death	Within seven days of the accident
Hazardous Materials	Fatality	The information received indicated that the death was due to the hazardous material involved	Not specified
Highway	Motor Vehicle Traffic Fatality	A death or injury resulting from motor vehicle accident injuries occurring on a trafficway	Within 30 days of the accident
Pipelines	Fatality	A death resulting from the failure or escape of gas, or the escape of liquid	Not specified
Rail Rapid and Transit	Casualty	1) Employees who are on duty and who are killed; 2) Casualties involving passengers or other personnel (off-duty employees, contractors, etc.) which occur at or in exclusive approached to or from faregates, or equivalent, or with the normal "paid" area, and which results in fatalities	Assaults, attempted suicides, and suicides are excluded
Railroad	Fatality	1) The death of any person from an injury;	Within 365 days of the accident/ incident
		2) The death of any railroad employee from occupation illness	Within 365 days after the occupational illness was diagnosed by a physician
Recreational Boating	Fatality	All deaths and missing persons resulting from an occurrence that involves a vessel or its equipment	Other than deaths by natural causes
Waterborne	Fatality	All deaths and missing persons resulting from a vessel casualty, such as a collision, fire, or explosion	Excludes nonvessel casualty-related deaths

entire range of BTS interests. The Department of Defense has provided BTS with the following assessment of data needs as a starting point for discussion.

HIGHWAYS

Critical

- An accurate and complete national bridge database for the Interstate and primary systems containing information on:
- Structural capacity to support heavy loads through identification of a national military load classification (MLC)
- Structure location (with accuracy of 1,000 to 1,500 meters)
- Vertical clearance capability (at least the width of one lane)
- Vehicle bypass capability around restrictive structures (less than 16 ft)
- A linear reference (mileposts) database compatible with state mileposts programs for Interstate and primary highway systems
- An accurate traffic volume (ADT) database for links of the Interstate and primary systems
- A congestion delay (time-windowed traffic density based on ADT) database for links/nodes of the Interstate and primary systems

Desirable

- An Interstate interchange configuration database

- A speed information (post limits) database for the Interstate and primary systems
- A route (link and node) population density database for the Interstate and primary systems

Reason for Need

- To provide enhanced analytical examination of military unit movements to determine ability to deploy in required time frames. Will allow DOD planners and strategists ability to make decisions based on available operational information regarding best/quickest/safest routing to seaports and airfields.

RAILROADS

Critical

- An accurate and complete rail line characteristics database for civil rail lines important to national defense (CRLIND) containing information on:
  - Carrier posted safety-maintenance speed classification
  - FRA safety-maintenance classification status
  - Vertical and lateral clearances
  - Freight (without passenger) traffic density
  - A national linear reference (mileposts) database for CRLIND

Desirable

- A database of abandonment status for CRLIND rail lines in the ICC process
- A route (link and node) population density database along CRLIND

Reason for Need

To monitor and confirm the defense readiness conditions of CRLIND for mobilization and deployment. This data will be used to conduct detailed examination of military equipment movements in required time frames.

INTERMODAL SYSTEMS

Critical

- An accurate and complete intermodal transfer point characteristics database containing information on:
  - Facility location (using a reference system compatible with DOT highway and rail line digitized networks)
  - Highway/rail line access (i.e., number of lanes/rail lines, double-stack capability, container reception/staging capacity, etc.
  - Container transfer capacity (TEUs per hour)

Desirable

- Intermodal transfer point information on:
  - Container handling equipment availability
  - Hours of operation
  - Ownership, servicing carriers, point-of-contact

Reason for Need

This information will be used by the Strategic Transportation Analysis system to model transfer of intermodal containers between the highway and rail networks in mobilization and deployment situations. It will also be used to identify key intermodal facilities that link defense important highways and rail lines.

BTS Perspectives from the *Transportation Statistics Annual Report*

BTS has established its own perspectives on information needs through the development of the *Transportation Statistics Annual Report.* Each preceding chapter concludes with a section on what we don't know as well as we should.

Major subjects requiring *basic information*:

- the location, condition, and physical performance of transportation services and facilities provided by the private sector;
- the location, condition, and physical performance of intermodal connections;
- the quantity and geographic distribution of commodity and passenger movements;
- the direct costs of transportation services to carry commodity and passenger flows;
- business travel;
- expenditures and revenues of for-hire carriers in passenger transportation, arrangers of transportation services, short-line railroads, and water transportation;
- the inventory and use of transporta-

tion resources controlled by establishments that are not primarily in the business of for-hire transportation; and
- fuel consumption and fuel economy based on real-world experience rather than laboratory conditions.

Major subjects requiring more reliable, comparable, or *detailed information*:
- the location, condition, and physical performance of transportation services and facilities provided by the public sector;
- the balance of trade related to transportation services and international travel;
- the characteristics and travel behavior of foreign visitors in the U.S. and of U.S. travelers abroad;
- motor vehicle miles of travel by vehicle type;
- safety (particularly with respect to definitions of terms); and
- environmental conditions affected by transportation.

Major subjects requiring better measures or analytical methods for improved understanding:
- congestion;
- relationships between transportation spending and economic activity, particularly with respect to international trade, employment, regional development, and the Gross Domestic Product;
- relationships between economic activity and the use of craft and vehicles.
- relationships between environmental quality and the use of craft and vehicles.
- the transportation needs of disadvantaged groups.

BTS was established in part because basic information on commodity movements, passenger movements, and intermodal connections was absent or out of date. Many additional topics requiring have been identified, some requiring new data collection and others requiring innovative measures or analytical methods to turn raw data into information. The topics related to the effects of transportation on our pocketbooks and the larger role of transportation in the economy require that the basic taxonomy of transportation industries and the accounting of transportation within the structure of the economy must also be more adequately defined.

Data collection needs are driven by quality problems as well as by gaps in existing data bases. The most common quality concern involves vehicle activity. Estimates of current vehicle activity are central to informed discussions of safety issues, tax policy, energy consumption, and environmental pollution. Although estimates of total vehicle activity are generally accepted, disaggregations by vehicle type or locality are often questioned. Existing data collections must be expanded and improved to provide the needed detail.

Data gaps and quality problems can often be ameliorated by combining existing data sets through record matching or statistical means; however, such data integration requires comparability of data collection methods, analytical procedures, and basic definitions. Comparability is also essential to understanding the differences among modes and to identifying opportunities for efficient intermodal activity. Comparability is difficult to achieve in transportation when definitions of even the most basic concepts vary among the modes. DOT's varied definitions for *fatality* illustrate the problem. (See table 8-3.)

Comparability is only one aspect of the larger problems of relevance and understandability of measures used to describe transportation. Productivity is a prime example, as recently documented in the Federal Highway Administration report, *An Examination of Transportation Industry Productivity Measures*.[5] Even if the daunting problems of inadequate data and classification systems to support existing measures are resolved, those measures may be so esoteric that no one except a professional economist can understand them. Even if the mechanics of the measures are understood, the philosophical basis of the measures are not always obvious. A quantitative measure of change in productivity typically interpreted as more efficient output and a benefit to society can also be interpreted as exploitation of labor that violates equity and other values to the detriment of society's members. We know neither whether things are getting better or worse, nor what we mean by better or worse.

The state of transportation statistics is not all negative; there are also enormous opportunities and challenges related to

emerging information technology. Electronic data interchange (EDI), global positioning systems (GPS), automated vehicle identification (AVI), weigh-in-motion (WIM), and portable computer technologies have the potential for acquiring greater amounts of information with higher precision at less cost and respondent burden than traditional forms of data collection based on paper, telephones, or personal interviews. Geographic information systems (GIS) promise significant improvements in the management, analysis, and visualization of data, although the promise has been made and broken several times over the past quarter century. The promise may be achieved this time because of the democratization of computers. Inexpensive microcomputers, spreadsheets, and CD-ROM technology are placing computational and data management power in the hands of small organizations and individuals, removing the hardware barriers that formerly restricted large data manipulation to organizations that could afford mainframe computers and computer programmers.

These opportunities also bring many challenges to BTS and to the transportation community. Emerging data acquisition technology will change the type of data that can be collected, as illustrated by WIM. Truck weight data was once collected by stopping vehicles at portable, roadside scales. The number of observations was limited by the cost to the data collector and the annoyance to the trucker, and data quality suffered from scale avoidance. Unobtrusive WIM technology allowed dramatic increases in observations at reduced costs, respondent burden, and bias from selective avoidance by truckers in a hurry. However, the technology has reduced the attribute detail for each observation. Information on the contents of the truck, the truck's owner, and the driver could be collected while the truck was being weighed on a static scale. WIM technology obtains only the weight of each axle and the spacing between axles. The resulting information is important and much improved in accuracy, but it lacks the richness of data obtained by the old methods. Supplemental data collections such as the Nationwide Truck Activity and Commodity Survey are needed to replace essential attributes that have been lost to the new technology. Unobtrusive data acquisition and administrative record matching technologies also raise societal issues such as privacy and confidentiality that must be respected.

The democratization of data and analysis through microcomputers, spreadsheets, and CD-ROM technology also creates challenges. These technologies expand dramatically the customer base to be served by BTS and others, creating a whole new class of data-hungry organizations and individuals. These technologies can also provide easy access to data that are difficult to use properly. Technology and cost no longer restrict data use to experienced *power* users. This places a greater burden on BTS and others to provide effective training in the proper use of the data. For example, five different weights are reported for each vehicle in the Census Bureau's Truck Inventory and Use Survey. The proper vehicle weight to use depends on the analysis being performed, and the appropriate choice is not always obvious. Training material for this data base is needed to explain the subtleties involved, in effect matching the power and flexibility of the data base with clarity and completeness in the instructions. BTS must increase its emphasis on user support as it increases the amount and sophistication of available data. BTS must also increase the sophistication of the training media to reach a growing customer base with available staff resources and to avoid overwhelming those customers with mammoth manuals.

The Future State of Transportation Statistics: A Potential Crisis with the Year 2000 Census

The future state of transportation statistics could be significantly changed by near-term decisions involving the Year 2000 Census of Population and Housing. The Census Bureau is considering a radical change in the way it will conduct the 2000 census that would not provide the benchmark travel-to-work data traditionally provided by the decennial census for transportation planning. All

other BTS activities to resolve data problems and capture opportunities for better information could be dwarfed by this potential crisis in transportation statistics, if appropriate census data cease to be collected.

Data from the decennial census are the backbone of the statistical system that supports the transportation planning process of our nation. DOT, as well as state and local transportation planning organizations, have relied on the consistent data collection provided by the decennial census since 1960 when transportation questions were first added to the census questionnaire. Today, these organizations are increasingly reliant on census data to implement the requirements of ISTEA and the Clean Air Act Amendments of 1990 (CAAA).

Special tabulations of 1990 census data for states and metropolitan regions, tailored to the needs of transportation planners and policy makers, are currently being released. At the same time, although the next census is six years in the future, planning for the 2000 census is well underway. The decisions will determine the transportation data and data products from the decennial census to meet the nation's data needs at the turn of the twenty-first century.

In its role of coordinating the collection of transportation data with information-gathering activities of other federal departments, BTS is working closely with the Bureau of the Census, the Office of Management and Budget, and other federal agencies to represent the interests of the transportation community in the 2000 census planning process. Furthermore, in response to its statutory responsibility for making transportation statistics readily accessible, BTS is playing an integral part in providing the 1990 census results to state and local transportation planners.

The History of Transportation Data from the Decennial Census

In the Beginning: The 1960 Census. DOT and the Bureau of the Census have a long tradition of working together to meet the nation's needs for transportation data. Transportation data were first collected in the 1960 census, when questions on city and county of work, means of transportation to work, and the number of automobiles available to each household were added to the census questionnaire. The pioneering regional transportation studies undertaken in many large cities in the latter half of the 1950s, and provisions of the Federal-Aid Highway Act of 1956 to provide alternative interstate service into, through, and around urban areas, gave impetus to the demand for comprehensive statistics on the amount and character of commuting within metropolitan communities.

The Federal-Aid Highway Act of 1962 required that approval of any federal-aid highway project in an urbanized area of 50,000 or more population be based on a continuing, comprehensive urban transportation planning process. By 1965, all then existing urbanized areas had an urban transportation planning process underway. This planning process created the need for more geographically detailed commuting data for urban areas to monitor local travel patterns.

The 1970 Census: the First Data for Traffic Analysis Zones. The development by the Census Bureau of computerized Address Coding Guides made it operationally feasible for the Bureau to collect the actual street address of work places in the 1970 census and code them to the city block level. Local transportation planning agencies, supported by state highway planning and research funds, assisted the Census Bureau in the development of these coding tools.

After the 1970 census, DOT contracted with the Bureau of the Census to produce compilations of block-level socioeconomic and travel-to-work data aggregated to traffic analysis zones. The standardized tabulations contained in this *Transportation Planning Package* were designed to provide a common data base for transportation studies and reduce processing costs. Metropolitan planning organizations submitted census block-to-traffic analysis zone equivalency files for their metropolitan areas, and the Census Bureau produced the traffic zone data packages on a cost-reimbursable basis.

In 1973, the Transportation Research Board of the National Academy of Sciences held the first national conference on "Census Data and Urban Transportation Planning" in Albuquerque, New Mexico. The conference was attended by

DOT and Census Bureau officials, as well as professionals from throughout the nation who were working in census and transportation planning activities, who reviewed their experiences in using the data from the 1970 census in the transportation planning process and formulated recommendations for improvements in the transportation data from the 1980 census.

The 1980 Census: A Fully-Developed Journey-to-Work Statistics Program. The energy crisis of the early 1970s heightened the need for transportation statistics to assess the transportation implications of energy shortages and costs. To meet this need for data, DOT sponsored a travel-to-work supplement to the Annual Housing Survey, conducted by the Bureau of the Census for the Department of Housing and Urban Development. The travel-to-work statistics collected in the American Housing Survey between 1975 and 1977 became the model for the transportation items collected in the 1980 census. The increasing importance with which the Bureau of the Census viewed transportation statistics also was demonstrated in 1978 when it established a Journey-to-Work Statistics Staff.

The 1980 census marked the first census for which the Census Bureau had a fully developed journey-to-work statistics program. The number of transportation questions asked in the census increased significantly in 1980. In addition to the inquiries on place of work, means of transportation to work, and the number of automobiles available to each household that had been included in the census in 1960 and 1970, the 1980 census asked new questions on carpooling arrangements, the number of persons in the carpool, travel time from home to work, the number of persons with disabilities that limited or prevented them from using public transportation, and the number of trucks and vans available.

The geographic reference materials used to code responses to the place-of-work question for the 1980 census were improved, resulting in an improvement in the accuracy and completeness of the coded data. Major employer files and reference lists of buildings, colleges and universities, military installations, shopping centers, and other employment sites were developed to code work place responses.

The development of computerized Geographic Base File/Dual Independent Map Encoding (GBF/DIME) Files by the Census Bureau to code addresses for the 1980 census also contributed greatly to the improved accuracy of block-level place-of-work data. Regional transportation planning organizations in the nation's metropolitan areas assisted the Census Bureau in the development of GBF/DIME Files by creating and updating the files based on local maps and expertise. DOT provided funding to support this cooperative effort.

Once again for the 1980 census DOT contracted with the Census Bureau to create a series of special tabulations in a Transportation Planning Package. Metropolitan planning organizations obtained the data tabulated for their traffic analysis zones on a cost-reimbursable basis.

After the 1980 census, the Transportation Research Board conducted the second "National Conference on Decennial Census Data for Transportation Planning." Held in Orlando, Florida in 1984, the conference was structured to provide a review of data user experience with the 1980 census and make recommendations for improvements in the program for the 1990 census. Officials from DOT and the Bureau of the Census participated in the conference along with state and metropolitan transportation planners.

The 1990 Census: A Refinement. The 1990 census transportation statistics program marked the continued refinement of transportation data available from the census, technical improvement in the geographic coding of place-of-work responses to small areas within metropolitan regions, and the creation and dissemination of innovative transportation data products. The 1990 census again included questions on place of work, means of transportation to work, carpooling, carpool occupancy, and travel time to work. An important new question on time of departure from home to work was added to the census questionnaire to allow tabulation of commuting patterns and characteristics by peak hours of travel. The questions on automobiles available and trucks or vans available were combined into one question on number of vehicles available. The question on public transportation disability was replaced with a

more general question that identified persons whose disabilities limited their ability to get around outside the home alone.

Two innovative technical advancements in place-of-work coding were made for 1990. The first innovation was the joint development by the Census Bureau and DOT of the Census/Metropolitan Planning Organization Cooperative Assistance Program. This program gave local metropolitan planning organizations the opportunity to assist the Census Bureau in improving the accuracy of place-of-work data for their region. Planning organizations were given the opportunity to take part in three activities: providing files of employers and their locations to the Census Bureau, working with major employers to ensure that their employees reported accurate work place addresses, and assisting the Census Bureau in coding place-of-work responses that census clerks could not code. More than 300 metropolitan planning organizations took part in these cooperative activities. The Federal Highway Administration made the costs incurred by the metropolitan planning organizations for this work an eligible activity for use of Federal-Aid Highway Planning Funds.

The second advancement in place-of-work coding was the implementation by the Census Bureau of an automated place-of-work coding system. Place-of-work addresses were keyed to create machine-readable files that were then matched to address coding and major employer files to assign a geographic codes to the place-of-work responses. Cases that could not be coded on the computer were sorted and clustered and referred to clerks for research and computer-assisted clerical coding. The automation of place-of-work coding allowed the Census Bureau to accomplish the coding operation efficiently and cost effectively.

Significant innovations in the dissemination of the journey-to-work data also have been achieved for the 1990 census. Two Transportation Planning Packages are being produced: statewide packages for each state and the District of Columbia, and urban packages for the transportation study area defined by each metropolitan planning organization. Production of the Transportation Planning Packages by the Bureau of the Census is sponsored by the state departments of transportation under a pooled funding arrangement with the American Association of State Highway and Transportation Officials. This pooled funding arrangement supports the production of data for the entire country instead of only those areas that decided to purchase the data as in previous censuses. Funding to develop the 1990 Census Transportation Planning Package Program was provided by the Federal Highway Administration and the Federal Transit Administration.

To make the data contained on the data tapes easily accessible and widely available, the Bureau of Transportation Statistics is releasing the 1990 Census Transportation Planning Packages on CD-ROM and providing software to display and retrieve the data. This revolutionary advancement in disseminating the census data in a format that is compatible with widely available microcomputers has democratized data that have been accessible only on mainframe computers in previous censuses.

In April, 1994, the Transportation Research Board will sponsor the third National Conference on Decennial Census Data for Transportation Planning. DOT officials, Census Bureau officials, and state and local transportation planners will meet in Irvine, California to review their experiences with using the 1990 census data for transportation planning and make recommendations for the 2000 census.

Uses of Decennial Census Data for Transportation Planning

Transportation data from the decennial census are used by DOT as a comprehensive database supporting development of new policies and programs, and as benchmark data with which to evaluate the impacts and overall effectiveness of previously implemented programs.

DOT works in partnership with states and local governments to assess project and corridor-level impacts of implemented plans, programs, and specific projects. In supporting ISTEA and CAAA, as well as other federal legislation such as the National Environmental Protection Act, Title VI of the Civil Rights Act of 1964, the Uniform Relocation Assistance Act, and the

Highway Safety Act, decennial census data facilitate a consistent level of responsible federal oversight and review of state and local plans and programs. For example, census data are an important tool in the environmental review process required under the National Environmental Protection Act to assess the potential impacts of yet-to-be implemented projects. In consideration of CAAA, journey-to-work data from the 2000 census will provide important feedback on the overall effectiveness of today's national air quality agenda. To respond to the requirements of the Americans With Disabilities Act for fully accessible transportation to all segments of the population, the data on persons with mobility limitations that are traditionally provided by the census provide an opportunity for the Department to conduct a nationwide assessment of service needs.

Decennial census data for small areas such as census tracts and traffic analysis zones are used by states and metropolitan planning organizations to meet the provisions of ISTEA, CAAA, and the Americans With Disabilities Act. ISTEA requirements for comprehensive planning, project selection, congestion management, and corridor preservation are not new concepts, but place greater emphasis on local decision-making which in turn creates greater demand for extensive, locality-specific information.

Regions cited for being in non-attainment of federal air quality standards must comply with Environmental Protection Agency and DOT requirements under CAAA. The transportation/air quality planning requirements of CAAA require state and local public agencies to prepare comprehensive vehicular travel and pollutant emissions profiles. To prepare these profiles requires analysis of detailed household and worker characteristics, means of travel, commuting patterns, and journey-to-work trip lengths obtained from the decennial census.

CAAA also requires severely polluted areas to compute regional average rates of vehicle occupancy in the commute to work. The census provides these data in a consistent manner nationwide.

Under CAAA, preparation of the State Implementation Plan and the comprehensive urban transportation planning process must be coordinated. Transportation facilities and projects proposed as part of the long-range transportation plan must be evaluated for their impact on air quality. Thus, forecasted travel volumes along specific routes are translated into forecasted traffic speeds and emissions. The results are used in determining conformity with the State Implementation Plan. Data from the decennial census are the basis of these forecasts.

DOT has initiated a Travel Model Improvement Program (TMIP) to help states and localities address their transportation and environmental needs and meet the requirements of ISTEA and CAAA. The General Accounting Office places significant importance on TMIP in its October, 1993 report, Transportation Infrastructure: Better Tools Needed for Making Decisions on Using ISTEA Funds Flexibility. Continued availability of census data are essential to the success of the TMIP.

Understanding regional travel patterns assists transit agencies in developing new services and revising existing services. These services may include vanpools and carpools, in addition to fixed rail and fixed route bus services. Small area census data for traffic analysis zones on journey-to-work characteristics are used for route planning, market analysis, publicity, and advertising.

The Americans With Disabilities Act requires states and local transit operators, with oversight and policy review by DOT, to provide service levels that are fully accessible to all segments of the population. Data from the census which describe the geographic distribution of persons with disabilities that limit their ability to get around outside the home are used to develop and improve transportation services for this specific population.

ISTEA Requirements for Census Data

Comprehensive Planning. ISTEA contains specific provisions requiring comprehensive transportation planning processes on a statewide basis, as well as at the metropolitan area level. States, local governments, and regional agencies must analyze the impacts of transportation plans, policies, and programs. The procedures involved are very data intensive, and small-area data from the decennial census

provide much of the required information. Principal among these procedures is travel forecasting.

The function of transportation models is to replicate how people travel, to model their travel to and from different locations, by time of day, purpose, and mode. Models are used to forecast how people will travel in the future, with assumptions made about transportation infrastructure development and changes, land use changes, parking cost and availability, and changes in individual travel behavior. By building these models, planners can evaluate different alternatives. For example, will adding carpool lanes along a particular highway reduce or increase congestion in the future, and how do these results compare with building general purpose lanes or increasing transit service. For most travel models, the forecasting horizon is twenty to thirty years. Thus, data from the 1990 census are used to test the reliability of current models to predict 1990 travel behavior, and to then forecast travel in 2000, 2010, and 2020.

The decennial census provides the baseline of household and person characteristics, origins and destinations of work trips, and travel characteristics for small areas such as traffic analysis zones used in regional and local travel demand modeling efforts. These forecasts are used by state, regional, and local agencies to develop, test, and refine methods for projecting future travel needs at the regional, subarea, and corridor levels. Using these models for travel forecasting allows analysis of alternative highway, transit, and multimodal-modal developments with various policy scenarios.

In addition to supplying data for travel forecasting, the decennial census provides important information for transportation planners to monitor trends in travel behavior. Census data permit the tracking of travel times and peak hours of travel by mode of travel and by residence and work location. The census also provides estimates and data for trend analyses of rates of carpooling and public transit use in the journey-to-work.

Transportation Improvement Program: Project Selection. ISTEA specifically requires that statewide and metropolitan transportation plans address broad issues such as land development and demographic growth, impacts of transportation facilities on population segments, and regional mobility and congestion levels. These plans must give consideration to the social, economic, and environmental effects, including air quality effects, of transportation plans and programs. Projects contained in Transportation Improvement Programs must be found to conform to the emissions reduction schedules in a state Implementation Plan. Census data on commuter travel flows and travel behavior patterns provide important baseline values against which Transportation Improvement Program projects can be evaluated and selected.

Traffic Congestion Management. ISTEA requires states, in cooperation with metropolitan planning organizations, to develop traffic congestion management systems. Transportation Control Measures and Travel Demand Management programs often use census data on the journey to work as baseline values from which to establish goals for increasing average vehicle occupancy and for decreasing single occupant vehicles. Census data also are used for preparing a comprehensive profile of peak period commuter flows.

Corridor Preservation. ISTEA provides a planning framework for early identification of transportation corridors needing some form of capacity expansion. Small area data from the census provide a basis for defining these corridors and the number and characteristics of residents and jobs affected.

Current Status of Planning for the 2000 Census

General Testing and Content Determination. The Census Bureau is currently planning the first full scale test of alternative census methods. This test will be conducted in the spring of 1995. The Bureau also plans to conduct a test of new and improved methods and procedures in 1996 and a dress rehearsal of the 2000 census design and methodology in 1998.

The content determination process is being conducted in parallel with the operational planning. Through mid-1995, the Census Bureau will work with federal agencies to identify their data needs with respect to uses of the data, legislative or other justifications for collecting the data

in the decennial census, and the geographic levels for which the data are required. The Bureau also will consult during this same period with data users outside the federal government to determine their needs as well.

In 1996, the Census Bureau plans to conduct a major test of content—new questions and question wording—for the 2000 census. By April 1, 1997, the Bureau must report to Congress the subjects it proposes to include in the 2000 census. By April 1, 1998, the Bureau must report to the Congress the actual questions it proposes to ask in the 2000 census.

The Continuous Measurement Alternative to the Decennial Census. The Census Bureau is seriously considering a radical change in the way it conducts the decennial census. The Bureau is studying the operational feasibility and cost of implementing what it calls a *continuous measurement* alternative for the 2000 census.

Under the continuous measurement design, the decennial census conducted in 2000 would collect on a 100-percent basis only the population and housing unit counts and minimal short-form population and housing data. The transportation characteristics traditionally obtained from a sample of households using the long-form questionnaire, as well as the whole range of social, economic, and housing data collected on the long form, would not be collected. Instead, the long form would be replaced with an Intercensal Long-Form Survey.

The Intercensal Long-Form Survey would comprise a monthly 350,000 household sample that would be cumulated to produce rolling averages over various periods of time. The survey would produce five-year moving averages of commuter travel between small areas such as census tracts or traffic analysis zones. For example, if the Intercensal Long-Form Survey begins in 1998 (as called for in the Census Bureau prototype), commuting data for traffic analysis zones could be released in 2003 based on the cumulated average of survey data collected in 1998-2002, in 2004 based on the cumulated average of survey data collected in 1999-2003, in 2005 based on the cumulated average of survey data collected in 2000-2004, and so on.

The five-year averages of commuting patterns between traffic analysis zones that continuous measurement cannot be used as point estimates of journey-to-work and related characteristics of small areas. Without the point estimates provided by previous censuses, state and local transportation planning organizations will have no benchmarks with which to validate their travel forecasting models.

DOT Participation in Planning for the 2000 Census. As in past censuses, DOT is working closely with the Census Bureau to ensure that the 2000 census will provide the data that are needed by transportation policy makers and planners at all levels of government. BTS represents the Department on the Policy Committee for the 2000 Census. This committee, comprised of representatives from federal agencies that depend on decennial census data for program implementation and evaluation, advises the Census Bureau on issues regarding census content and operations, and monitors the 2000 planning process on behalf of its constituent data users.

In response to the Office of Management and Budget's request for federal agency needs for data from the 2000 census, BTS submitted on behalf of the DOT documentation describing the transportation data needed from the 2000 census, the uses of the data for federal, state, and local transportation planning, and the legislation that requires the planning activities which depend so heavily on the decennial census data. BTS is supporting a study to determine the implications of Continuous Measurement data for the traditional uses of decennial census data in transportation planning, such as calibrating travel forecasting models. The results of this study will be provided to the Census Bureau to assist the Bureau in its decision on the method of conducting the 2000 census.

BTS is working closely with the Committee on National Statistics Panel on Census Requirements in the Year 2000 in its congressionally mandated study to assess the needs for data collected in the decennial census. BTS is preparing a case study of the uses of small-area data from the decennial census in transportation planning. This case study will describe the legislative requirements for transportation data from the census, the uses of the data to fulfill those legislative requirements by federal, state, and local

transportation planners, major limitations of data currently available from the census, and alternative sources of the information traditionally collected in the census. The transportation case study will be included in the Panel's final report to Congress, which is scheduled to be completed in late 1994.

To keep the transportation planning profession informed about the status of 2000 census planning, BTS will participate with representatives from the Federal Highway Administration and the Federal Transit Administration, as well as state and local transportation officials, in two sessions on the decennial census at the 1994 Annual Meeting of the Transportation Research Board (TRB). The first session will focus on the uses and applications of the 1990 census data for transportation planning. The second session will deal with future state and local needs for data from the 2000 census and the Census Bureau's plans for meeting those needs. These TRB sessions will be the precursor for the third decennial National Conference on Decennial Census Data for Transportation Planning, to be held in March, 1994. The proceedings of that conference will be submitted to the Bureau of the Census, the Office of Management and Budget, and Congress to help guide the planning for the 2000 census.

Recent Congressional Action in 2000 Census Planning. Congress has reaffirmed its commitment to providing the decennial census data needed to administer federal programs. In guidance included in the House-Senate conference report on the Census Bureau's fiscal year 1994 budget request, the Congress stated its expectation that the Secretary of Commerce and the Office of Management and Budget will ensure that the data requirements of federal departments and agencies, as well as state and local government data needs, are considered in the planning for the 2000 census.

The conference report on the Census Bureau's fiscal year 1994 budget also stated that the conferees expect that other federal departments and agencies with significant data requirements, for which the decennial census is determined to be the most effective means of collection, will reimburse the Census Bureau for a portion of the costs of planning for and conducting the Year 2000 Census. The Census Bureau is currently seeking clarification of congressional intent on this statement.

A cost-reimbursable census would be unprecedented in the history of the decennial census. However, the inclusion by Congress of funding for collection of decennial census data within the budgets of data-user agencies may have significant advantages. For example, it would serve to focus federal agency data needs and allow for collection of additional data if agencies choose to provide the necessary funds. As paying customers, a cost-reimbursable census would give agencies more control over census content, processing requirements, and the timing of data availability. Under this scenario, cost-reimbursable special tabulations such as the 1990 Census Transportation Planning Package could be produced in a more timely manner as a standard decennial census product.

BTS Action in 2000 Census Planning

BTS understands the vital importance of the census to the transportation community, and has already committed significant staff resources to work with Census and others on several committees and conferences for 2000 census planning. BTS has initiated research on the impacts of continuous measurement on transportation planning models. BTS recognizes that its future activities with states and metropolitan planning organizations would have to expand dramatically if the Year 2000 Census fails to deliver data upon which states and metropolitan planning organizations have come to depend.

The Future of Transportation Statistics: Transportation and Economic Classification

As stated throughout this volume, transportation is inadequately represented in most analyses of the national economy. The reason stems largely from the way in which economic activity is classified under federal statistical standards. The problem is exacerbated by the lack of a

federal statistical standard for the products carried by the transportation system. Fortunately, OMB has created an opportunity to rectify these problems through the charter of the Economic Classification Policy Committee (ECPC);

ECPC has been established to consider changes to the Standard Industrial Classification (SIC) system and related federal statistical standards. These standards relate to the classification of establishments, products, employment, and economic geography, and affect both data collected by other agencies and the accounting of transportation's role in the national economy. BTS is particularly concerned with economic classification related to commodities, which will be a major design issue for the next Commodity Flow Survey. BTS therefore approaches issues of economic classification as a data user, data provider, and statistical policy agent for the transportation community.

BTS is continuing DOT's involvement in economic classification that started when the Department became an active participant on OMB's Technical Committee on Industrial Classification (TCIC) for the 1987 revisions to the SIC system. DOT interest in this area has increased significantly by the growing number of policy questions related to the interdependence of transportation, commerce, and the economy.

General Problems with the 1987 SIC System

Deliberations of the Technical Committee on Industrial Classification (TCIC) for the most recent revisions to the SIC system in 1987 revealed that traditional concepts are being eroded by the growing number and importance of multi-activity establishments, particularly between industries that are converging in the development of new products and services. This is illustrated by explosive growth of intermodal transportation services, such as the growing number establishments that transcend the traditional boundaries between motor carriers and airlines for express letter and parcel delivery service. The emergence of multi-function establishments creates or exacerbates four issues that were not addressed in the 1987 SIC Manual. These issues include: definition of the establishment concept in an increasingly integrated economy; better identification of auxiliary establishments; inconsistencies between the 4-digit Industry Group, 3-digit Industry Group, and 2-digit Major Group levels of the SIC hierarchy; and overlap across boundaries of Divisions.

The Need for a Broader Definition of Establishment. The concept of establishments is easy to implement when individual facilities have distinct and stable locations. Increasingly integrated manufacturing processes, the nearly ubiquitous availability of freeways and air transportation, and a revolution in the economics and technology of computers and communications are bringing establishments closer together functionally while allowing them to become geographically dispersed and footloose. Establishments are becoming mobile nodes on a dynamic network.

The SIC Manual recognizes that many establishments in transportation, communications, and public utilities in Division E include geographically dispersed but functionally integrated activities. Similar recognition is needed in other Divisions, thanks to electronic networks and new organizational structures.

The concept of establishments as geographically dispersed systems rather than single locations is used in the SIC Manual primarily to delineate the employees and revenues to be counted with a specific establishment. The concept is generally not used to determine the establishment's Industry. The occasional exception is in Division E. Local pick up and delivery service that is part of an intercity carrier is classified in the Industry for intercity or long-distance service by that mode of transportation; local service that is not an integral part of the intercity service is classified in the local Industry for that mode.

Consistent recognition that the function of the network defines the function of the establishment on that network is needed across Divisions, but is difficult under current classification concepts based on the activity of the establishment rather than the enterprise (company or network) that it serves. Until a broader definition of establishment is adopted, the basis of classifying establishments will vary between what goes on in the establishment without regard to other units and what the establishment does as part of a network of other units.

Identification of Auxiliaries: The Need for More Detail. The SIC Manual recognizes two kinds of establishments: operating and auxiliary. An operating establishment sells most of its goods or services to establishments owned by other enterprises, and is classified by what it makes or does. An auxiliary establishment sells most of its goods and services to other establishments of the enterprise that also owns it, and is classified by the activities of the establishments that it serves. For example, a local motor carrier that serves a grocery chain is classified as an operating establishment with local trucking in Industry Group 421. A local motor carrier subsidiary of the grocery chain is classified as an auxiliary establishment in Industry 5411 (Grocery Stores).

Under the 1987 SIC Manual, a fifth digit has been added to indicate what the auxiliary establishment does for the Industry that it serves. The trucking example would be classified as a warehousing auxiliary if the trucking arm of the grocery store was based with the warehouse, or as an auxiliary not elsewhere classified. Most auxiliary establishments are central administrative offices, and a large percentage are in-house research and development laboratories.

The new fifth digit does not provide enough detail for policy analysis. The need for more detailed identification of auxiliary activities is particularly acute in the trucking example. Less than half of all trucking activity in the United States is performed by for-hire motor carriers. The majority is performed by private trucking, such as the trucking auxiliary of the grocery chain already mentioned. Many government policies involve establishments that are engaged in trucking, whether private or for hire, and statistics are needed on both segments of the industry. Data on operating establishments engaged in trucking are easily found in Industry Group 421, but trucking auxiliaries are not identified even with the newly ordained fifth digit. Data on the auxiliary establishments are also needed to evaluate shifts in revenues, employment, and other characteristics of the trucking industry, since the shift may reflect a change in ownership rather than true change in economic activity. In some states, a grocery chain that spins off its trucking auxiliary to become a motor carrier can cause significant changes in the Industry statistics even though the trucks may be providing the same service to the same stores.

These problems are conceptually easy to resolve by expanding the auxiliary function code to four digits. Rather than use the four categories of auxiliary activity in the new fifth digit, the auxiliary activity could be identified by the code of the Industry into which the establishment would have been classified if it had been an operating establishment. The trucking auxiliary of the grocery chain would thus be classified by the number 5411.4214. The TCIC selected the single digit code over this option for the 1987 revision on the grounds that implementation would be too difficult at that time.

Expansion of detail would allow much more accurate accounting of economic activity, and would resolve much of the current debate over how much of the growth in services is real or a statistical artifact. The costs and benefits of such expansion of detail require further exploration.

Inconsistent Hierarchical Structure. The continued growth of multi-function and intermodal establishments highlights fundamental weaknesses of the SIC system's hierarchy of Industries, Industry Groups, and Major Groups: the lack of a rigorously defined, consistent hierarchy across the four-, three-, and two-digit levels; the inherent constraints of a base 10 numbering system; and, the lack of places to classify inter-industry activities.

A rigorously defined, consistent hierarchy above the Industry level is important in the SIC system because:

- substantial data are collected or published only at the two- and three-digit level;
- the hierarchy specifies relationships among Industries, providing direction to coding and to aggregation of statistics; and
- the TCIC was very reluctant to move activities across Industry Group and Major Group boundaries.

The importance of this hierarchy is in contrast to the lack of rigor in its definition. Only Industries are defined by rigorous, detailed, explicit rules. Most TCIC recommendations for reorganizing Industry Groups and Major Groups were based on intuitive reasonableness or on

the limits of a base 10 numbering system. (Industries were reallocated among Industry Groups when more than nine were together, and the not-elsewhere-classified category occasionally became a dumping ground for industries that could both be accommodated rather than the location of Industries that are too small or hard to classify.) This lack of rigor has resulted in inconsistencies and caprice, such as the grouping of public warehousing with trucking in Major Group 42 even though the warehousing industries are more logically placed with transportation services (Major Group 47).

Even if the hierarchy were rigorously defined, there are few places for interindustry activities to be classified. Activities which are the outgrowth of an interaction between Industries, such as piggyback service between trucks in Major Group 42 and railroads in Major Group 40, are typically buried in one of the affected Industries or under "Not Elsewhere Classified." Proposals for new Industries are useful but only piecemeal patches to the problem, especially when the affected Industries reside in different Industry Groups.

The inconsistent hierarchy and other problems cannot be resolved completely without a draconian overhaul of the SIC system. The SIC system might have to be restructured from a top-down approach that starts with Divisions, rather than from the TCIC's bottom-up approach that starts with Industries. The requisite magnitude of change may never be possible given the substantial costs of changing data collection programs and converting long-term series of data to a new SIC system.

Boundaries. The problems with the hierarchical structure of the SIC system extend to the Division level, although the issue is primarily one of boundaries rather than of how many and what type of categories should be defined. The boundary problems are most notable between the Divisions for manufacturing and services, and between Public Administration and the other Divisions. Boundary problems also exist between the Divisions for manufacturing, wholesale trade, and retail trade.

Problems with the boundary between Manufacturing (Division D) and Services (Division I) involve a growing number of borderline industries that are packaging services into goods and turning goods into services. Indeed, the entire concept of *services* is a problematic one. The government does not have a rigorous definition of what constitutes a service rather than a good. The shift from services to goods is illustrated by the new Industry 7372 (Prepackaged Software), the location of which was extensively debated because computer programs were traditionally produced as a service until microcomputers created a mass market for software. When is a computer program a good or service? Is it a question of whether the program is sold in shrink-wrap plastic?

The shift goods to services is illustrated by Publishing (Major Group 27), where many printed goods are becoming more popular in electronic form and potentially causing establishments to move from their manufacturing roots in Division D to less readily apparent categories in Division I (such as Industry 7375 for Information Retrieval Services). The publishers of the Official Airline Guide would move from manufacturing to services if revenues from the electronic version exceed sales of the book.

The borderline Industries are particularly important given the pervasive references to the manufacturing and service sectors of the economy using a plethora of explicit and implied definitions of those sectors. The often-reported shift of the Nation's economy from manufacturing to services is due in part to the changing character of goods and services just noted and to the increasing tendency of manufacturers to contract with other firms for transportation and other services that were previously performed the manufacturer's own employees.

Commodity Classification

BTS particularly appreciates ECPC's desire to include product classification in the discussion of economic classification. BTS believes that much of the pressure for change in the SIC would be reduced by the development of a standard product classification system that includes both physical commodities and services rendered. For example, a product classification system could provide an effective solution to several of the problems described for auxiliaries and borderline industries.

BTS concern with product classification has been intensified by experience with the Commodity Flow Survey (CFS). CFS was conducted throughout calendar year 1993 by the Bureau of the Census with substantial DOT support to obtain the quantity and value of shipments by manufacturers, merchant wholesalers, and selected other industries by type of commodity, mode of transportation, state and region of origin, and state and region of destination. The railroad industry's Standard Transportation Commodity Classification (STCC) system is used in the CFS to provide comparability with the predecessors to the CFS in 1963 through 1977. STCC codes are also used because no other domestic classification system has similar detail and hierarchical structure based on characteristics of concern to DOT.

STCC codes have not been a panacea. Shippers have difficulties reporting by STCC codes if they do not use railroads. The Bureau of the Census has spent considerable effort bridging between STCC codes and their own industry-based product codes. Bridges between STCC codes and international systems are an additional challenge.

BTS would replace STCC codes with a governmentwide statistical standard if a system that meets the Bureau's commodity classification needs is established. BTS would also embrace a product classification system that reduced the magnitude of needed change in the SIC system. Major changes to the SIC are disruptive to historical series, costly for others to implement, and potentially disruptive to the establishment-based CFS sample frame.

BTS Recommendations

BTS has recommended that the ECPC commit to establishing a complete product classification system in time for the 1997 Economic Census, including the CFS, and in time for use in baseline studies related to the North American Free Trade Agreement.[6] BTS believes that the discussion of product classification should focus initially on whether the system should be based on the characteristics of the producer, the transportability of the product, or both. Once that issue is resolved, the effort should shift to consideration of whether to adopt or modify an existing international system such as the Standard International Transportation Classification and the Central Product Classification.

BTS believes that it is possible to implement a product classification system in time for the 1997 CFS and other Census activities and minimize the need for disruptive changes to the SIC system. The requisite effort will be significant, but necessary if effective change is to be accomplished before 2002. BTS has offered significant support for the many activities needed to research and implement a product classification system and to evaluate changes to the very large number of transportation-related industries in the SIC.

What We Need to Know the Most: Priority Areas Requiring BTS Attention

BTS concurs with *Data for Decisions* in placing inadequate information on commodity and passenger movements at the center of most problems with current transportation statistics. The needs for this basic information and BTS plans to meet those needs as its highest priority effort are explained fully in the BTS report, *Purpose and Status of the Multimodal Commodity and Passenger Flow Surveys.*[7]

BTS believes that other issues requir ing immediate attention include: inventory of the geographic locations and characteristics of transportation facilities and services, particularly those involving intermodal transfers; the decennial census and economic classification as described in this chapter; the establishment of common definitions throughout transportation statistics, particularly in the areas of safety; and the rethinking of basic measures of transportation and its consequences, such as congestion and economic productivity. In all of these pursuits, BTS places a premium on identifying the temporal and geographic variation of transportation and its consequences in addition to determining systemwide averages.

Sources

Figure

Figure 8-1: Bureau of Transportation Statistics.

Tables

Table 8-1: Bureau of Transportation Statistics.

Table 8-2: Transportation Research Board, *Data for Decisions Special Report 234*, p. 50-57.

Table 8-3: Volpe National Transportation Center.

Endnotes

1. *Data for Decisions*, page 45.
2. U.S. Department of Transportation, *Transportation Information* (Report to the Committee on Appropriations, U.S. house of Representatives, from the Secretary of Transportation), May, 1969.
3. Transportation Research Board Special Report 234
4. *Data for Decisions*, p. 59.
5. Searching for Solutions No. 8, July, 1993.
6. Bureau of Transportation Statistics correspondence of May 28, 1993, to Jack E. Triplett, ECPC Chairman, Bureau of Economic Analysis, in response to the ECPC *Federal Register* notice of March 31, 1993.
7. Report of Bureau of Transportation Statistics to the Committees on Appropriations of the United States Senate and U.S. House of Representatives, May 20, 1993.